

Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

What is Claimed:

1. (Currently Amended) A micro-electro-mechanical device, characterized by a body of ~~only semiconductor material~~ having a thickness and defining a mobile part and a fixed part,

said body formed from a single layer of semiconductor material extending through the entire thickness of said body;

said mobile part comprising a mobile platform, supporting arms extending from said mobile platform to said fixed part, and mobile electrodes fixed to said mobile platform;

said fixed part comprising fixed electrodes facing said mobile electrodes, a first biasing portion fixed to said fixed electrodes, a second biasing portion fixed to said supporting arms, and an insulation region of insulating material extending through the entire thickness of said body,

wherein said insulation region electrically insulates at least one of said first and second biasing portions from the rest of said fixed part.

2. (Previously Presented) The device according to claim 1, wherein said fixed electrodes extend from said first biasing portion, and said supporting arms extend as a continuation of said second biasing portion.

3. (Previously Presented) The device according to claim 1, wherein at least one through trench extends through the entire thickness of said body between said mobile part and said fixed part, and said at least one of said first and second biasing portions is further delimited by said through trench.

4. (Previously Presented) A micro-electro-mechanical device, characterized by a body of semiconductor material having a thickness and defining a mobile part and a fixed part,

said mobile part comprising a mobile platform, supporting arms extending from said mobile platform to said fixed part, and mobile electrodes fixed to said mobile platform;

said fixed part comprising fixed electrodes facing said mobile electrodes, a first biasing portion fixed to said fixed electrodes, a second biasing portion fixed to said supporting arms, and an insulation region of insulating material extending through the entire thickness of said body,

wherein said insulation region electrically insulates at least one of said first and second biasing portions from the rest of said fixed part,

wherein at least one through trench extends through the entire thickness of said body between said mobile part and said fixed part, and said at least one of said first and second biasing portions is further delimited by said through trench, and

wherein said insulation region has an arched shape with ends terminating on said through trench.

5. (Currently Amended) A micro-electro-mechanical device, characterized by a body of semiconductor material having a thickness and defining a mobile part and a fixed part,

said body formed from a single layer of semiconductor material extending through the entire thickness of said body;

said mobile part comprising a mobile platform, supporting arms extending from said mobile platform to said fixed part, and mobile electrodes fixed to said mobile platform;

said fixed part comprising fixed electrodes facing said mobile electrodes, a first biasing portion fixed to said fixed electrodes, a second biasing portion fixed to said supporting arms, and an insulation region of insulating material extending through the entire thickness of said body,

wherein said insulation region electrically insulates at least one of said first and second biasing portions from the rest of said fixed part,

wherein at least one through trench extends through the entire thickness of said body between said mobile part and said fixed part, and said at least one of said first and second biasing portions is further delimited by said through trench, and

wherein said insulating region comprises at least one first and one second insulating portion and a connecting portion, said connecting portion extends laterally with respect to said through trench between said insulating portions.

6. (Previously Presented) The device according to claim 3, wherein said insulation region surrounds said second biasing portion.

7. (Original) The device according to claim 1, wherein said body is of monocrystalline silicon.

8. (Original) The device according to claim 1, constituting a micro-actuator for hard-disk drives.

9. (Original) The device according to claim 1, wherein contact pads are formed above said mobile platform, and electrical-connection lines extend from said pads on said supporting arms.

10. (Withdrawn) A process for manufacturing a micro-electro-mechanical device, comprising the steps of:

forming a body of semiconductor material having a thickness;

forming, in said body, a mobile part and a fixed part,

said mobile part comprising a platform, supporting arms extending from said mobile platform to said fixed part, and mobile electrodes fixed to said platform;

said fixed part comprising fixed electrodes facing said mobile electrodes, at least one first biasing region fixed to said fixed electrodes, and one second biasing region fixed to said supporting arms, and

forming, in said body, an insulating region of insulating material extending through the entire thickness of said body,

wherein said insulating region is shaped so as to insulate electrically at least one between said first and second biasing regions from the rest of said fixed part.

11. (Withdrawn) The process according to claim 10, wherein said step of forming a body comprises providing a substrate of semiconductor material having a thickness greater than said body and thinning out said substrate from the rear, and said step of forming an insulating region comprises, before thinning out said substrate, forming an insulating structure in said substrate extending from a first surface of said substrate down to a depth equal to at least the thickness of said body so that, during said step of thinning out, said insulating structure is reached from behind.
12. (Withdrawn) The process according to claim 11, wherein said step of forming an insulating structure comprises the steps of:
making insulating trenches in said substrate; and
filling, at least partially, said insulating trenches with said insulating material.
13. (Withdrawn) The process according to claim 11, wherein, before said step of thinning out said substrate, the step of bonding said substrate to a supporting wafer is performed.
14. (Withdrawn) The process according to claim 13, comprising, before said step of bonding, the steps of:
forming electrical-connection structures above said first surface;
forming bonding regions; and
turning said substrate upside down with said first surface facing said supporting wafer, and
after said step of thinning out said substrate, the steps of:
defining said fixed and mobile parts;
dicing said substrate and removing said supporting wafer.
15. (Withdrawn) The process according to claim 13, wherein said step of bonding comprises turning said substrate upside down with said first surface facing said supporting wafer,
said step of thinning out said substrate comprises forming a second surface opposite to said first surface,

after said step of thinning out said substrate, the step of forming electrical-connection structures above said second surface is performed, and

after said step of thinning out said substrate, the steps of defining said fixed and mobile parts, thinning out said supporting wafer and dicing said substrate are performed.

16. (Withdrawn) The process according to claim 10, further comprising the step of bonding to said mobile part a slider for the reading/writing of hard disks.

17. (Currently Amended) A micro-electro-mechanical device, comprising:

a moveable portion comprising,

a moveable platform, and

a moveable electrode attached to the moveable platform;

a fixed portion having ~~a thickness and a fixed position relative to the moveable portion and formed from a semiconductor material extending through an entire thickness of the fixed portion~~, the fixed portion comprising,

a first biasing portion,

a fixed electrode attached to the first biasing portion and facing the moveable electrode,

a second biasing portion, and

a region of insulating material extending through the entire thickness of the fixed portion to electrically insulate the first biasing portion from the second biasing portion; and

support arms that attach the moveable portion to the fixed portion.

18. (Previously Presented) The device of claim 17, further comprising:

multiple moveable electrodes attached to the moveable platform; and

multiple fixed electrodes attached to the first biasing portion.

19. (Previously Presented) The device of claim 17, further comprising:

multiple first biasing portions; and

multiple fixed electrodes attached to each biasing portion.

20. (Original) The device of claim 17 wherein:
the moveable platform is substantially circular, and
the moveable electrodes extend radially.
21. (Currently Amended) A disk drive, comprising:
a disk operable to store data; and
a read/write head assembly comprising,
a micro-electro-mechanical device, comprising:
 a moveable portion comprising,
 a moveable platform, and
 a moveable electrode attached to the moveable platform;
 a fixed portion having ~~a thickness and~~ a fixed position relative to the
moveable portion and formed from a semiconductor material extending through
an entire thickness of the fixed portion, the fixed portion comprising,
 a first biasing portion,
 a fixed electrode attached to the first biasing portion and facing the
moveable electrode,
 a second biasing portion, and
 a region of insulating material extending through the entire
thickness of the fixed portion to electrically insulate the first biasing portion
from the second biasing portion; and
support arms that attach the moveable portion to the fixed portion; and
a read/write head attached to the moveable platform.
22. (Currently Amended) An electronic system, comprising:
a disk drive, comprising,
a disk operable to store data, and
a micro-electro-mechanical device, comprising:
 a moveable portion comprising,
 a moveable platform, and
 a moveable electrode attached to the moveable platform;

a fixed portion having ~~a thickness and~~ a fixed position relative to the moveable portion and formed from a semiconductor material extending through an entire thickness of the fixed portion, the fixed portion comprising,

a first biasing portion,

a fixed electrode attached to the first biasing portion and facing the moveable electrode,

a second biasing portion, and

a region of insulating material extending through the entire thickness of the fixed portion to electrically insulate the first biasing portion from the second biasing portion; and
support arms that attach the moveable portion to the fixed portion.

23. (Withdrawn) A method for manufacturing of a micro-actuator, comprising:

forming first trenches in a first wafer;

filling the first trenches with insulating material;

attaching a second wafer to a first side of the first wafer for support during manufacturing;

exposing the trenches through a second side of the first wafer to form a first biasing region and a second biasing region separated by the insulating material; and

forming second trenches in the first wafer to define fixed electrodes that are integral with the first biasing region and moveable electrodes adjacent to the fixed electrodes and elastically coupled to the second biasing region.

24. (Withdrawn) The method of claim 23, further comprising:

coating the first side of the first wafer with an insulating layer; and

forming contact openings in the insulating layer.

25. (Withdrawn) The method of claim 24, further comprising:

forming electrical-connection structures on the insulating layer; and

forming contact pads in the contact openings.

26. (Withdrawn) The method of claim 23 wherein forming the second trenches comprises forming the second trenches such that the fixed electrodes and the moveable electrodes are intertwined.
27. (Withdrawn) The method of claim 25, further comprising removing the second wafer from the first wafer.
28. (Withdrawn) The method of claim 25, further comprising:
forming a platform that is attached to the moveable electrodes; and
attaching a read/write head to the platform.
29. (Withdrawn) A method for the manufacture of a magnetic hard disk micro-actuator, comprising:
forming first trenches in a first side of a first wafer;
filling the first trenches with insulating material;
attaching a second wafer to the first side of the first wafer to provide a substrate;
exposing the trenches through a second side of the first wafer to form a first biasing region and a second biasing region separated by the insulating material;
forming second trenches in the first wafer to define fixed electrodes that are integral with the first biasing region and moveable electrodes adjacent to the fixed electrodes and elastically coupled to the second biasing region.
30. (Withdrawn) The method of claim 29, further comprising:
coating the second side of the first wafer with an insulating layer; and
forming contact openings in the insulating layer.
31. (Withdrawn) The method of claim 30, further comprising:
forming electrical-connection structures on the insulating layer; and
forming contact pads in the contact openings.
32. (Withdrawn) The method of claim 29, further comprising cutting the first wafer into dies to form fixed electrodes extending from the first biasing region towards a platform wherein the fixed electrodes and the moveable electrodes are intertwined.

33. (Withdrawn) The method of claim 29, further comprising thinning the second wafer.
34. (Withdrawn) The method of claim 33 wherein thinning the second wafer further comprises mechanically grinding the second wafer to a thickness of approximately 100 micrometers.
35. (Withdrawn) The method of claim 29 wherein forming first trenches comprises forming the first trenches in U-shapes.
36. (Withdrawn) The method of claim 29 wherein attaching a second wafer to the first side of the first wafer further comprises a low temperature thermal treating wherein connecting regions react with the first wafer.
37. (Withdrawn) The method of claim 36 wherein:
the connecting regions further comprise gold, and
the treating further comprises forming a gold/silicon eutectic.
38. (Withdrawn) The method of claim 36 wherein:
the connecting regions further comprise palladium, and
the treating further comprises forming a silicide.
39. (Withdrawn) The method of claim 33 wherein the fixed electrodes are further than substantially 2 micrometers from the moveable electrodes.